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THE ADVANCE IN OUR KNOWLEDGE OF THE CAUSATION AND METHODS OF PREVENTION OF STOCK DISEASES IN SOUTH AFRICA DURING THE LAST TEN YEARS.[1]

I.

TEN years ago, when I first came to South Africa, I was led to take an interest in the various great stock diseases which do so much damage and so retard the progress of South Africa as a stock-raising country. I thought, therefore, that a good subject for my address, in the center of the foremost stock-raising colony of South Africa, would be a review of the work done in advancing our knowledge, during the last ten years, of the causation and methods of prevention of stock diseases in South Africa.

South Africa is particularly rich in animal diseases, every species of domestic animal seemingly having one or more specially adapted for its destruction. Now it is evident that, in an address of this kind, it will be impossible to take up every stock disease, but I think you will agree with me that those shown on this table are among the most important: East coast fever; ordinary redwater or Texas fever; biliary fever of horses; malignant jaundice of dogs; nagana or tsetse-fly disease; trypanosomiasis of cattle; rinderpest; horse-sickness; catarrhal fever in sheep; heart-water of sheep, goats and cattle.

Now we may group these diseases in vari-

[1] Address of the president of the Physiological Section of the British Association for the Advancement of Science, South Africa, 1905.

ous ways; for example, as below, where they are divided into two main divisions: *A* division, in which the parasite is known; and *B* division, in which the parasite is unknown.

A. PARASITE KNOWN.

I. Diseases caused by parasites belonging to the genus *Piroplasma:* (1) East coast fever (Koch), *P. parvum;* (2) Redwater or Texas fever, *P. bigeminum* (Theiler); (3) Biliary fever of horses, mules and donkeys, *P. equi;* (4) Malignant jaundice of dogs, *P. canis.*

II. Diseases caused by parasites belonging to the genus *Trypanosome:* (1) Nagana or tsetse-fly disease, *T. brucei* (Bradford and Plimmer); (2) Trypanosomiasis of cattle, *T. theileri* (Bruce).

B. PARASITE UNKNOWN.

I. Rinderpest.

II. Horse-sickness. Catarrhal fever of sheep; heart-water of sheep, goats and cattle.

I. DISEASES CAUSED BY PARASITES BELONGING TO THE GENUS PIROPLASMA.

1. *East Coast Fever.*

The first important stock disease I would draw your attention to, then, is east coast fever. This name was given to it by Professor Robert Koch, of Berlin. In the Transvaal the disease is usually called Rhodesian redwater. This term is not a good one, since the disease is not restricted to Rhodesia, nor did it arise there, nor is this a disease similar to the ordinary redwater. Ten years ago, when I first came to South Africa, east coast fever was unknown in the Transvaal. The first known outbreak occurred only some three and a half years ago, when it broke out at Koomati and Neilspruit, in the Barberton district, and in the east of the colony. The disease had broken out some time previously in Rhodesia, and the outbreaks in both colonies were due to infection from Portuguese territory. Although this disease has only been introduced to the country during the last few years, it has already produced an enormous amount of damage among stock, and is probably the most dangerous disease that the people of the Transvaal have to cope with at the present time, and for some years to come.

In the Annual Report of the Transvaal Department of Agriculture there is a most excellent report by Mr. Stockman, the then principal veterinary surgeon, on the work of the veterinary division for the year 1903–1904. A large part of this report is given up to east coast fever, and I must here express my indebtedness to Mr. Stockman for much of the following account of this disease. In the same annual report there is also an account by Dr. Theiler, the veterinary bacteriologist, of the experimental work. Messrs. Stockman and Theiler evidently worked together, and I must congratulate them on the immense amount of good, useful work done by them, and I would also congratulate the government on having had the services of two such accomplished and energetic gentlemen during the late troublesome times. Unfortunately for the Transvaal, Mr. Stockman has accepted the post of veterinary adviser to the board of agriculture in England, but I have no doubt his successor, Mr. Gray, from Rhodesia, will continue the good work begun by him.

East coast fever was first studied by Professor Koch at Dar-el-Salaam, in German East Africa, and he at first mistook it for ordinary redwater. It seems to occur as an endemic disease along a great part of the east coast of Africa, but appears to be restricted to a narrow belt along this coastline. The cattle inhabiting this region have become immune to the disease, and are, therefore, not affected by it. Cattle passing through the coast district to the interior, or brought to the coast district from the interior, are apt to take the disease and die. It was by the importation of cattle, therefore, which had passed through the

dangerous coast district that the disease was introduced into Rhodesia and into the Transvaal. On this map which I throw on the screen I have marked out the probable endemic area of this disease, and in the next slide the present distribution of the disease in the Transvaal is also marked out.

Nature of the Disease.—This disease only attacks cattle, but in them is an exceedingly fatal malady; in every hundred cattle attacked only about five recover from the disease. The duration of the disease after the first symptoms have occurred is about ten days.

The cause of the disease is a minute blood parasite called the *Piroplasma parvum* (Theiler). This parasite lives in the interior of the red blood corpuscles.

I now throw on the screen a representation of the blood from a case of Rhodesian redwater, magnified about a thousand times, showing these small piroplasmata in the interior of the red blood corpuscles. As in the case of so many of these blood diseases, the parasite causing it is carried from the sick to the healthy by means of a blood-sucking parasite. In this particular disease the tick which most commonly transfers the poison or living parasite from one animal to another is known as the 'brown tick,' *Rhipicephalus appendiculatus*. Koch supposed that the common 'blue tick' was the agent. The credit belongs to Dr. Lounsbury and Dr. Theiler of having shown that it is chiefly the 'brown tick' which acts as carrier; but Theiler has proved that *R. simus* is also able to transmit the disease. Without the intervention of a tick, as far as we know at present, it is quite impossible that the parasite of this disease can be transferred from one animal to another. For example, if we take a quantity of blood containing enormous numbers of these piroplasmata, and inject it into the blood circulation of a healthy animal, the latter does not take the disease. In the same way, if cattle affected by east coast fever are placed among healthy cattle in a part of the country where none of these 'brown ticks' are found, the disease does not spread. It is evident, therefore, that some metamorphosis of the parasite must take place in the interior of the tick, and this new form of the parasite is introduced by the tick into a healthy animal, and so produces the disease. In this particular disease the virus or infective agent is not transmitted through the egg of the tick, as is the case in some of these parasitic diseases, but only in the intermediate stages of the tick's development; that is to say, the larva which emerges from the egg of the tick is incapable of giving the disease. What happens is this: the larva creeps on to an infected animal and sucks some of its blood. It then drops off, lies among the roots of the grass, and passes through its first moult. The nympha, which is the name given to the creature after its first moult, is capable of transferring the disease to a healthy animal; that is to say, if it crawls on to a healthy animal and sucks blood from it, it at the same time infects this healthy animal with the germ of east coast fever. In the same way, if a nympha sucks infected blood from a sick animal, it is able, after it has moulted into the adult stage or imago, again to give rise to the disease if placed, or if it crawls, upon a healthy animal.

The Life-history of the Brown Tick.—I throw on the screen a slide representing the four stages of the life-history of the brown tick: The egg, the larva, the nympha and the adult or imago. The eggs are laid on the surface of the ground by the adult females, who deposit several thousand at a time; and these hatch out naturally, if the weather is warm and damp, in twenty-eight days. But this period of incubation of the

eggs may vary very greatly owing to differences in temperature. Immediately after the larva is born it crawls to the summit of a blade of grass or grass stem, and there awaits the passage of some animal. If an ox passes by and grazes on the grass, the tick at once crawls on to the animal, and, having secured a favorable position, starts to suck the ox's blood. It remains on the ox for some three or more days, when, having filled itself with blood, it drops off and lies among the grass. The first moult, under favorable conditions, takes twenty-one days, when the nympha emerges. In the same way the nympha crawls on to an animal and fills itself with blood. As a nympha it also remains on the animal for about three or four days. It again drops off into the grass, and at the end of eighteen days emerges from its second moult as the perfect adult male or female. The males and females again crawl on to an ox, where they mate. After this the female tick ingests a large quantity of blood, which is meant for the nourishment of the eggs, and again drops off, sometimes as early as the fourth day, into the surrounding grass. After about six days she lays her eggs in the ground, and the cycle begins again.

These ticks are very hardy, and in the intermediate stages can resist starvation for long periods, so that a larva or nympha or adult tick may remain perched at the end of a blade of grass for some months without finding an opportunity of transferring itself to a suitable animal. On this account it comes about that even if all infected cattle are removed from a field the ticks in that field will remain capable of [redacted] cattle which may be allowed into this field for a period of about a year. At the end of a year or fifteen months, however, the infective ticks are all dead, and clean cattle may be allowed into the field without any risk. If one takes these facts into consideration it will be seen that a single ox may spread this disease for a distance of some 200 miles, if trekking through the country at the average rate of ten miles a day. For example, an ox is infected by a tick; for fourteen days the animal remains apparently perfectly well; it has no signs of disease, nor has it any fever. It is capable of doing its ten miles' trek a day. At the end of fourteen days the temperature begins to rise, and the animal begins to sicken with the disease, but for the next six days the ox is, as a rule, able to do its ordinary day's march. During most of this time the brown ticks have been crawling on to this ox, becoming infected, and dropping off every three or four days. It can readily, therefore, be seen how much mischief a single infected animal can do to a country between the time of its being infected by the tick and its death some twenty-four days later. As a matter of experience, however, the disease has never been found to make a jump in this way of more than fifty or sixty miles, as, of course, it is very rare that a transport carrier will take his oxen more than that distance during the twenty days.

At the present time it may be said that there are about 500 infected farms in the Transvaal. During last year some 15,000 cattle died of the disease, and in the affected districts it may be said that there are still some 30,000 cattle alive. When one considers the value of the cattle dead of this disease, which may be said to be about £200,000, it is evident that money spent on the scientific investigation of the [redacted] money well spent. I am informed that all the South African governments are cutting down their estimates this year, and are inclined to reduce their veterinary staffs and the amounts devoted to research regarding

animal diseases. Ladies and gentlemen, if this is so, I have no hesitation in saying that this is the maddest sort of economy and the shortest-sighted of policies.

Methods of Combating the Disease.—During the last three years an immense amount of work has been done in the elucidation of this disease—how the animals are infected, how the poison is spread from the sick to the healthy, and so on. In 1903 Professor Koch was asked by the South African colonies to study this disease, in order to try to find some method of artificial inoculation or some other means of prevention. He did his work in Rhodesia, and especially directed his energies towards discovering some method of preventive inoculation. At first it was thought that he would be successful in this quest, as in his second report he announced that he had succeeded in producing a modified form of the disease by direct inoculation with the blood of sick and recovered animals. As you are all aware, the only method of conferring a useful immunity upon an animal is to make it pass through an attack of the disease itself, so modified as not to give rise to above a few deaths in every hundred inoculated. This is the method that has been employed in such diseases as rinderpest, anthrax, pleuro-pneumonia and many other diseases. The great difficulty in this disease in finding a method of preventive inoculation is the fact that the blood of an affected animal does not give rise to the disease in a healthy one when directly transferred under the skin of the latter. It is only after its passage through the body [redacted] is evidently, on the face of it, difficult to so modify the parasite during its sojourn in the tick's body as to reduce its virulence to a sufficient degree.

Professor Koch in his third and fourth reports recommended that cattle should be immunized by weekly or fortnightly inoculations of blood from recovered animals, extending over a period of five months. Even though this method of Koch had given the desired result, viz., that it rendered the inoculated cattle immune to the disease, it is evident that the method itself can hardly be made a practicable one on a large scale in the field. The expense and trouble of inoculating cattle on twenty different occasions would be very great. It is apparent now that Professor Koch fell into error through mixing up east coast fever with ordinary redwater. His plan of preventive inoculation was, however, tried on a large scale in Rhodesia by Mr. Gray, now the principal veterinary surgeon, Transvaal, and found to be useless. At present, therefore, we must look to some other means of preventing the disease and driving it out of the country than preventive inoculation.

Dipping.—Much can be done to prevent the spread of this disease by ordinary methods. For example, in the case of Texas fever in Queensland dipping cattle in solutions of arsenic or paraffin, in order to destroy the ticks, has met with very fair success; but in the case of this disease we can not expect to get as good results as in the case of redwater. The species of tick which conveys Texas fever remains on the same animal through all its moults, instead of falling to the ground between each different one. If it is not possible to spray or dip cattle oftener than once in ten or fifteen days, it is evident that ticks may [redacted] so escape destruction by the dipping operation. At the same time every infected tick that is killed by spraying or dipping operations is a source of infection destroyed.

Fencing of Farms.—Again, the fencing

of farms must also be useful in the same direction. As the ticks do not travel to any extent when they fall among the grass, it is evident that the cattle on a clean farm which is properly fenced will not become infected by this disease, although all the country round about should be infected. This fencing of farms and subdividing the farm itself into several portions is a most important factor in the prevention of contagious diseases amongst stock. It is, of course, impossible that this can be done at once, as the expense would be prohibitive.

Moving Cattle from Infected Pasture to Clean Pasture.—From a study of this disease and a study of the life-history of the tick it is evident that by a combination of dipping or spraying the cattle so as to destroy almost all the ticks, slaughtering the sick, and moving the apparently healthy on to clean veld—and repeating this, if necessary, a second or third time—it is obvious that by these means, if circumstances are favorable, an outbreak of this disease may be nipped in the bud without much loss to the stock.

Stamping out the Disease.—In May, 1904, an inter-colonial conference held at Cape Town resolved that the only effective method of eradicating east coast fever is to kill off all the cattle in the infected areas, and to leave such areas free of cattle for some eighteen months. By this means all the centers of infection would be destroyed, and at the end of eighteen months, as all the infected ticks would be dead, it is evident that the disease would be completely stamped out. There is no doubt that this drastic method would be the quickest and most complete one of getting rid of this extremely harassing disease. If compensation were given, it could be done at a cost of, say, a quarter of a million. The government decided, however, that on account of the difficulty of carrying out such a drastic scheme another policy had to be considered. This policy provides for the fencing-in of infected farms, places, lands or roads, on generous terms; the compulsory slaughter of stock with compensation in the case of isolated outbreaks; the removal of all oxen from infected or suspected farms; and, lastly, the stabling of milch cows in infected areas. It is quite evident that under this less drastic policy the final stamping-out of the disease will be a much slower process than if the more drastic scheme of compulsory slaughter of all cattle on infected areas had been carried out. The benefits, however, from the modified scheme are undoubted; and if carried out thoroughly and intelligently for a period of several years will probably result in the stamping-out of the disease.

Allow me to sum up in regard to the advance in our knowledge of this important stock disease during the last ten years. Ten years ago nothing was known. Now the causation of the disease has been made out very fully; the parasite that causes it is known; the ticks which carry the infection are known. Although no method of conferring immunity on healthy cattle has been found out, or any medicinal treatment discovered which will cure the sick animal, yet our knowledge of the life-history of the parasite and the tick enables regulations to be framed which, if patiently carried out, must be crowned with success.

2. *Redwater or Texas Fever.*

I may dismiss this disease in a few words. It is a most interesting disease and of great importance to stock farmers. It only affects cattle.

Geographical Distribution.—It is a disease found in almost every part of the world. It was first studied in North America; hence the name Texas fever. To Kilborne and Smith is due the honor of elu-

cidating the causation of this disease, and their work forms one of the most interesting chapters in the history of pathological science. They discovered that it was caused by the presence in the red blood corpuscles of a protozoal parasite closely related to the parasite found in east coast fever—the *Piroplasma parvum*. This organism is called *Piroplasma bigeminum*. They further discovered that this parasite was conveyed from sick to healthy cattle by means of a tick. They also showed that the cattle born and bred in certain southern districts are immune to the disease, whereas cattle in the northern districts are susceptible. Hence, if southern cattle were driven into the northern district, they gave rise to a fatal disease among the northern cattle; and, *vice versa*, if the susceptible northern cattle were driven into the southern district among the apparently healthy cattle of that district, they took Texas fever and died.

Texas fever was introduced about 1870, and is now endemic throughout most of South Africa. For many years the native cattle have been immune to the disease; that is to say, on account of being born and bred in a Texas fever locality they had inherited a degree of resistance to the disease which enabled them to pass through an attack when they were young, and so they became immune. But there is one peculiarity about Texas fever which does not occur in Rhodesian tick fever, and that is that the blood of an animal which has recovered from Texas fever remains infective—the germs remain latent—and so the native cattle of South Africa, although apparently healthy, are capable of infecting imported susceptible cattle with this very fatal malady. This is what makes it so difficult to import prize stock into this country.

When the Boers visited Mooi River, at the beginning of the war, they found a prize short-horn carefully stabled in Mr. P. D. Simmon's farm. They killed most of his stock for food, but left this short-horn bull alive. When they left the farm they turned this bull into the nearest field, in order, of course, that it might procure food. They had much better have eaten it. It promptly took Texas fever and died.

This disease, then, has become of secondary importance to South Africa in these days. The native cattle have become naturally immune, and the disease is only fatal to susceptible imported cattle. This, of course, discourages the importation of prize stock; but with the knowledge we possess it ought to be possible, by good stabling and prevention of contact with tick-infected cattle, to keep the prize stock alive for a reasonable time. The question of the feasibility of immunizing the prize stock while calves in England might be considered.

In regard to methods of conferring immunity on susceptible cattle many have been tried, but none are absolutely free from risk.

We may sum up in regard to redwater or Texas fever by saying that our knowledge of its causation and methods of prevention is much the same as it was ten years ago. The work done by Smith and Kilborne on this disease was of such a brilliant nature, and was done so thoroughly, that little has been left for later workers to do.

3. *Biliary Fever of Horses, Mules and Donkeys.*

This is a disease of horses, mules and donkeys very similar to redwater in cattle, and is caused by a closely allied parasite, the *Piroplasma equi*, discovered for the first time in South Africa by Bordet, Danysz and Theiler, and named by Laveran, of Paris.

It is similar to redwater, in that animals which have recovered from the disease re-

main a source of infection during the remainder of their lives to susceptible animals. The native South African horse is, like the cattle, immune to the disease. It is also conveyed by a tick, which has been shown by Theiler to be the 'red tick' (*Rhipicephalus evertsi*), the infection being taken in the nymphal and transferred in the adult stage. Theiler has also made the very important observation that if a horse is injected with blood from a donkey which has recovered from the disease, as a rule a mild form of the disease is produced, so that this opens up a method of immunizing susceptible horses which may probably prove of practical value. Theiler has also made another curious discovery. This disease of horses was found to greatly complicate certain immunizing experiments he was making against horse-sickness. He found he was introducing the *Piroplasma equi* at the same time he injected horse-sickness virus. But he found out that as the virus of horse-sickness keeps its virulence for years, whilst the *Piroplasma equi* dies out in a short time, this danger could be avoided by keeping the horse-sickness serum and virus for some time before using it.

4. *Malignant Jaundice of Dogs.*

This disease is most important to sportsmen or to importers of valuable dogs, as most of these are attacked sooner or later by this disease, and most of them succumb. It is also caused by a species of *Piroplasma* (*Piroplasma canis*), and is spread by the dog tick (*Hæmophysalis leachii*).

Like redwater and biliary fever, the blood of dogs which have recovered remains infective.

The story of the tick infection is a curious one, and the credit of its discovery is due to Lounsbury. It is only in the adult stage that the tick is capable of producing the disease. It is, therefore, evident that the *Piroplasma* must remain latent in the egg, the larval and nymphal stages, and only attain activity in the adult stage.

According to Theiler there exists a peculiar phenomenon which may be made use of to confer immunity. The blood of a dog which has recovered from this disease and has been hyper-immunized is, as mentioned above, capable of giving rise to the disease in a susceptible dog. Now, if serum be obtained from this blood and a quantity added to a small amount of the blood, this infected blood loses its infectivity and no disease results.

II. DISEASES CAUSED BY PARASITES BELONGING TO THE GENUS TRYPANOSOME.

1. *Nagana or Tsetse-fly Disease.*

We now come to the second group of diseases. These are also caused by blood parasites belonging to the same class of living things as the *Piroplasma,* but which are free organisms, swimming in the fluid part of the blood, and not contained in the red blood corpuscles, as are the others.

The first of this group I would draw your attention to is that disease called nagana or the tsetse-fly disease.

This fly renders thousands of square miles of Africa uninhabitable. No horses, cattle, nor dogs can venture, even for a day, into the so-called 'fly country.' Now what was our knowledge of this disease ten years ago? At that time it was thought that the tsetse-fly killed animals by injecting a poison into them, in the same way as a snake kills its prey. Nothing was known as to the nature of this poison in 1894. In 1895, on account of serious losses among the native cattle in Zululand from this plague, the then governor of Natal and Zululand, Sir Walter Hely-Hutchinson, started the investigation of this disease. The result of this investigation was the discovery that tsetse-fly disease was not caused by a simple poison elaborated by the fly, as formerly

believed, but that the cause of the disease was a minute blood parasite which gained entrance to the blood of the animals. This parasite is known by the name *Trypanosoma*, which signifies a screw-like body.

Ten years ago two species only had attracted much attention—one living in the blood of healthy rats, discovered by Surgeon-Major Lewis in India; and the other, a trypanosome, found in the blood of horses and mules suffering from a disease known in India as 'surra.' As the result of this investigation in Zululand, which lasted two years, it was proved that this trypanosome was undoubtedly the cause of the death of the horses and cattle struck by the fly, and that the tsetse-fly merely acted as a carrier of this blood parasite.

Here is a representation of the trypanosome of nagana on the screen. These trypanosomes consist of a single cell; are sinuous, worm-like creatures, provided with a macronucleus and micronucleus, a long terminal flagellum, and a narrow fin-like membrane continuous with the flagellum and running the whole length of the body. When alive they are extremely rapid in their movements, constantly dashing about, and lashing the red blood corpuscles into motion with their flagellum. They swim equally well with either extremity in front. These organisms multiply in the blood by simple longitudinal division, and often become so numerous as to number several millions in every drop of blood. They are sucked, along with the blood, into the stomach of the fly, live and multiply in the alimentary tract for several days, and, when the fly has its next feed on an animal, take the opportunity of gaining access to the blood of the new host, and so set up the disease.

Let me now throw on the screen a representation of the tsetse-fly (*Glossina morsitans*) which does all the mischief. Experiments were made which showed that the fly could convey the parasite from affected to healthy animals for at least forty-eight hours. It is a curious fact that among all the blood-sucking flies the tsetse fly alone has this power, and up to the present the cause of this has not been thoroughly cleared up. Lately, however, evidence has been brought forward to show that an enormous multiplication and development of the trypanosomes take place in the fly's intestine, a few trypanosomes multiplying to masses containing numberless parasites within twenty-four hours. Now, if this multiplication only takes place in the intestine of the tsetse-fly, and not in the other kinds of biting flies, this would probably account for the curious connection between the tsetse-fly and the disease. This multiplication of the trypanosomes in the tsetse-fly was discovered by Gray and Tulloch, two young army medical officers, while working in Uganda on 'sleeping sickness' during the present year.

Not only was it found that the tsetse-flies could convey the disease from sick to healthy animals, but it was also proved that the wild tsetse-flies brought from the 'fly country' and straightway placed on healthy animals also gave rise to the disease. The question then arose as to where the tsetse-flies living in the 'fly country' came by the trypanosomes. There were no sick horses or cattle in the 'fly country.' Investigation brought to light the curious fact that most of the wild animals—the buffalo, the koodoo, the wildebeeste—carried the trypanosomes in small numbers in their blood, and it was from them that the fly obtained the parasite. The wild animals act as a reservoir of the disease. The trypanosome seems to live in the blood of the wild animals without doing them any harm, just as the rat trypanosome lives in the blood of healthy rats; but when introduced into the

blood of such domestic animals as the horse, the dog or ox it gives rise to a rapidly fatal disease. The discovery that the wild animals act as a reservoir of the disease accounted for the curious fact that tsetse-fly disease disappears from a tract of country as soon as the wild animals are killed off or driven away.

In 1895 the living trypanosome which causes the tsetse-fly disease was sent to England in the blood of living dogs, in order that it might be studied in the English laboratories. These trypanosomes have been kept alive ever since by passage from animal to animal, and have been sent all over Europe and America, so that our knowledge of this kind of blood parasite has rapidly grown.

Koch, in a recent address, says that our knowledge of protozoal diseases is based on three great discoveries—that of the malarial parasite, by Laveran; of the *Piroplasma bigeminum*, the cause of Texas fever or redwater in cattle, by Smith; and, lastly, this discovery of a trypanosome in tsetse-fly disease.

We may, therefore, I think, congratulate ourselves on the growth of our knowledge of this great stock disease during the last ten years.

Since 1895 many other trypanosome diseases have been discovered in all parts of the world. The latest and most important of these is one which affects human beings, and is known as 'sleeping sickness.' This 'sleeping sickness,' which occurs on the West Coast of Africa, particularly in the basin of the Congo, has within the last few years spread eastward into Uganda, has already swept off some hundreds of thousands of victims, is spreading down the Nile, has spread all round the shores of Lake Victoria, and is still spreading southward round Lakes Albert and Albert Edward. This disease is in all respects similar to the nagana or tsetse-fly disease of South Africa, except that it is caused by another species of trypanosome and carried from the sick to the healthy by means of another species of tsetse-fly, viz., the *Glossina palpalis*.

I now throw on the screen a map of Africa, showing, as far as is known up to the present, the various fly districts, and you will see from this map that it is not at all improbable that this human tsetse-fly disease may spread southward through the various fly districts to the Zambesi, and may even penetrate as far as the fly districts of the Transvaal and Zululand.

I am sorry to say that, in spite of innumerable experiments directed towards the discovery of some method of vaccination or inoculation against these trypanosome diseases, nothing definite, up to the present time, has been discovered. At present there does not seem to be any likelihood that a serum can be prepared which will render animals immune to the tsetse-fly disease. In the same way it has also been found impossible, up to the present, to so modify the virulence of the trypanosome as to give rise to a modified, non-fatal form of the disease. Again, all attempts at discovering a medicine or drug which will have the power of killing off the parasites within the animal organism, without at the same time killing the animal itself, have not as yet been successful, although some drugs, such as arsenic and certain aniline dyes (Ehrlich), have a very marked effect in prolonging the life of the animal. As this disease is fatal to almost every domestic animal it attacks, it seems very improbable that there is much chance of cultivating an immune race of horses, dogs or cattle which will be able to withstand the action of the parasite. It is quite evident that if an acquired immunity of this kind could be brought about, such a race of immune animals would now be found; but, as a matter

of fact, there are no horses, dogs or cattle in the 'fly country.' In other protozoal diseases, such as the *Piroplasmata*, this acquired immunity seems to come about fairly readily.

To sum up, then, the increase in our knowledge of tsetse-fly disease during the last ten years, we may say that we have discovered the cause in the shape of the small blood parasite *Trypanosoma;* we have found that the reservoir of the disease exists in the wild animals, and that we can blot out this disease from any particular tract of country by the simple expedient of destroying or driving away the wild animals. We still have no means of preventive inoculation or successful medicinal treatment in this disease.

2. *Trypanosomiasis of Cattle.*

This disease seems to be widespread over all South Africa. It can not be said to be of much practical importance, as the cattle infected do not seem to be seriously affected by it. It is caused by a species of trypanosome remarkable for its large size, which was discovered by Dr. Theiler some years ago, and named *T. theileri.*

Dr. Theiler states that it is conveyed from animal to animal by the common horse-fly, *Hippabosca rufipes.*

This, then, is a short account of the trypanosome diseases which affect South Africa.

Of late years the tsetse-fly disease has become of less practical importance to the Transvaal, from which it has practically disappeared. This is due to the disappearance of the game, killed off by rinderpest; but with the preservation and restoration of the reserves with big game the disease is certain to reappear. Why the fly should disappear with the game is not known.

D. BRUCE.

(To be continued.)

EUROPEAN AND AMERICAN SCIENCE.

ONE of the important accomplishments, doubtless, of the International Congress of Arts and Science held in connection with the exposition at St. Louis was, simply, the bringing to this country of a large number of learned men from other nations. Some of these men had visited America before, but many of them crossed the Atlantic last autumn for the first time and viewed Americans and American institutions with, as it were, a virgin sense. A number of those who made the trip have recorded their impressions in addresses or journal-articles. It would be a worthy task, should these increase in number, to collect and to publish them together, for aside from the gratification of the curiosity of seeing ourselves as others see us, it could scarcely fail to be instructive for us to study the observations and comments of men of the high type of those who were invited to the congress.

Of the foreign scientists who attended the St. Louis meeting and have given public expression to their ideas of America, one of the most distinguished and discerning is the professor of anatomy in the University of Berlin. It was not Professor Waldeyer's first visit to America; fond of travel and widely-travelled as he is, it was not for a man such as he to have left so long America unvisited. Moreover, an omnivorous reader, Waldeyer is more or less familiar with American literature; he numbers, too, among his friends many American scientists and literary men; indeed, many young biologists and anatomists from America have, in part at least, received their training in his laboratory. By personal observation, by correspondence, by reading and by multiple contact with educated Americans, Professor Waldeyer has had, more than most foreigners, opportunities for familiarizing himself with American science and American thought.

It must, therefore, be of especial interest to people in this country to know that he has recently referred at some length to the subject of the relation of Europe (and especially Germany) to American science, and to learn, in brief at least, what are his views concerning it.

Waldeyer discussed the matter in a *Festrede* delivered at an open session of the Royal Prussian Academy of Sciences in Berlin early this year.[1] The occasion was the double celebration of the Kaiser's birth-[illegible] erick II. The first part of the address dealt with the political relations of Germany and America, with especial reference to Frederick's attitude toward the American republic at its birth, a natural topic in view of the recent presentation of the statue of Frederick the Great to the American nation. It is the second part of the address which is of chief interest to the readers of SCIENCE, as it considers the special matter of the relation of Europe and of Germany to science in America. The whole address is characterized by a wish for harmonic relations, by a keen desire to foster and favor international scientific intercourse and by a plea for the avoidance of everything in the way of mutual misunderstanding and unseemly discord. It is a liberal and broad-minded statement, certainly as fully lenient to America as one could ask; it can scarcely fail to cement good feeling and to promote intercontinental harmony among scientific men. On adverting to this special topic Waldeyer points out that if two peoples are to cooperate in the work of the advancement of culture, the first necessity is mutual respect between them. Each must have something good, something self-achieved to offer, each must preserve its own individuality, not with obtrusive ostentation, but quietly and with that certainty which naturally accompanies the feeling of health and strength; for nations are like men—he who has not confidence in himself will also soon be given up by others. He urges the necessity of stilling those tendencies which arise from time to time in one nation to unjustly threaten or injure another, the desirability of getting rid of prejudices and of clearing up misunderstandings and unjust suspicions of the other, the importance [illegible] good [illegible] ignorant, owing to lack of knowledge of the nature of the people and of their civic and social institutions. This, he points out, is why Germans, in order to maintain a healthy and useful relation to American science, must, above all, know how the American thinks about culture and science, what the present position of science and scientific investigation in America really is, and how it is likely to shape itself in the near future.

Waldeyer admits that in Germany the false opinion that the American turns predominantly toward material interests and that he has but little inclination for purely scientific things is still widespread. Those who hold it, he says, forget America's great universities—Harvard, nearly 300 years old, with its 5,000 students per year; Yale, more than 200 years old; Princeton; Brown; the University of Pennsylvania, contemporaneous in foundation with Göttingen; Columbia, established seven decades ago; and young institutions, like Johns Hopkins, Cornell, the University of Chicago and the University of California, already grown to powerful positions in the country. If Germany bore in mind the great public libraries which exist in America, with their magnificent equipment, their easy access and their prodigious use by all classes, in-

[1] Waldeyer, W., 'Festrede,' *Sitzber. d. kg. Preuss. Akad. d. Wissensch.*, 1905, IV., 105–121.

cluding the working people, such a wrong impression could not prevail. The American's recognition of the fact that culture brings freedom with it, and his realization that, in a country where every one has the choice of sinking or swimming, a good education is a necessity for him who will hold himself above water in the fierce struggle, have led to the expenditure of great sums for public schools, for advanced education of all sorts, for museums, collections, laboratories, and the like, with results as good

[illegible]

ress in this regard formerly, confesses himself surprised at the advances made in the last decade. They surpass, he says, all expectations. "One needs no special prophetic gift to predict that, in fifty years, the United States will, as regards good arrangement, ease of use and wealth of what is offered, far outdo Germany."

Before attempting to answer the question, 'With all this liberal provision in the way of making arrangements for scientific work, has anything already been achieved in America?' Waldeyer turns to an intermediate consideration, to a general discussion, namely, of the factors which permit and foster the development of unusual men. The relative potency of heredity and environment is considered. The basis for any special capacity, be it bodily or mental, is an inborn gift of nature; it can not be increased in a given organization beyond the limits permitted by that organization. A mathematician can not be made of a man whose brain has not the necessary endowment therefore, any more than a singer can be developed if the individual be too defective in temporal lobe, ear or larynx. Here and there such natural capacities appear hereditarily in families, but as often or oftener the reverse appears to be the case. And it is not wealth or social position which produces these extraordinary capacities; on the contrary, capable heads of the first rank emerge just as often from among the masses; they come from those in poor circumstances as frequently as from families that have long enjoyed conditions of preferment—an illustration of the beneficent and compensative justice of nature! That certain races are preferred can not be denied—the history of science teaches it. They are those races whose individuals, along with a healthy [illegible] as [illegible] to the body-mass. Climate, using the word in its broadest sense, here, doubtless, plays a part. Neither the prevailing darkness of the poles nor the flood of sunlight at the equator is suitable; it is a temperate climate in countries manifoldly broken up into land and water, where the soil is fertile, and the whole gamut of seasons is run through, which must be designated as most favorable. In such a climate men must work, but the work rewards and strengthens. Not that this climatic factor works directly; rather its action is such that it gives rise to strong, healthy men with superior brains. On the other hand, it is just as true that culture already attained and institutions of favorable influence already established, such as superior schools, well-organized and liberally endowed libraries and provision for the interchange of mental products, often help to permit intellectually important men to appear. As of two equally well-organized muscles, that becomes more efficient which is given the opportunity to exercise and test itself; so of two equivalent brains, the one which is offered the more abundant and better intellectual nourishment and the greater opportunity for exercise will yield the higher product. Many a highly endowed head has failed to become fully active, owing to

the existence of barriers to its development. Great geniuses like Napoleon I., Shakespeare and Gauss may, it is true, overcome every obstacle; by virtue of their extraordinary creative power they can do without and still not be held back; but easily accessible aids will undoubtedly awaken to able performances men of capacity, who otherwise would slumber.

On comparing 'old Europe' with the United States Waldeyer points out that the 'climatic' factor is in both instances all that can be desired. Though in western North America there are wide areas less favorably situated, a vast proportion of the country is as favorably located and formed as any part of Europe. The type of man is the same, indeed the whole of Europe has sent, in large part, of its best to contribute to the population of the United States. The means of culture are the same; in many respects America has the advantage, especially as regards ease of use and multiplicity of institutions. There can be no doubt, then, that in America effective men and women must develop in all spheres. Waldeyer calls the attention of his countrymen to the fact that it is by no means, as some think, in the natural sciences and technical subjects that Americans have already distinguished themselves; he cites, in evidence, a list of naturalists, economists, jurists, philologists, philosophers and historians of the first rank.

Some of the reasons for German failure to comprehend Americans are made clear. To understand the people of the United States properly, one must, he emphasizes, keep in view the fact that even their oldest towns never had walls, that there have never been feuds between cities, nor struggles between lords and men, that compulsory service and burdens other than those self-imposed are unheard of, and that the state does not trouble itself about religious creeds, nor these about the state. All this affords a wide horizon and creates a feeling of personal independence—a feeling which Americans inherit from the founders of the republic and which is traditionally maintained in their bringing-up.

The magnificent equipment of America's scientific institutions reflects the national character. High praise is accorded by Waldeyer to the Smithsonian Institution, from which so many foreigners have received favors; to the Washington Academy of Sciences, with its various subdivisions; to the American Association for the Advancement of Science, and to the National Educational Association. But as a biologist, the Berlin anatomist is best able to judge of the state of the biological sciences here. After referring to his personally repeated conviction of the advances making in America he says: "I find that over there they stand equal to us in all essential points, in the kind and method of scientific work, in the value of the same, in the equipment and arrangement of laboratories, in materials for instruction and in the form and mode of imparting knowledge. Visit the great workshop of Alexander Agassiz in Cambridge; the anatomical institutes of Huntington in New York, at Columbia University, and of Mall in Baltimore; the Peabody Museum, so brilliantly filled by Marsh, at Yale; the anthropological museum in New York, etc., and you will say that I am right. J. Orth has recently made a similar statement. In a few years the new buildings of the Medical School at Harvard will be ready; * * * it may be prophesied that in them we shall have the best to be seen anywhere."

In view of the present standing and promise for the future of science in America, Waldeyer, proceeding with his address, urges the maintenance and strengthening

of the ties which now knit together the scientific interests of Europe and America. A comparison of the scientific 'capital' of the two countries, the climatic prerequisites and the creative and thinking human material, reveals an equivalence. If Europe is still ahead in antiquity of culture material and historical substrata, it will not be so long before America catches up. While European scientific institutions are good, care must be taken lest the freedom of their management be restricted, and Waldeyer warns his colleagues that otherwise Europe will soon fall behind America, for science and art flourish only in the open air!

In one large feature Europe is still, Waldeyer declares, ahead of America, and that is in the making of great scientific discoveries and the formation of those theories which have opened up wholly new domains of knowledge. To Europe, he says, belongs the credit of a surprisingly large number of new chemical elements, spectral analysis and, with it, astrophysics, the great discoveries in the chemistry of dyes and sugars, the physical chemistry of solutions, the liquefaction and condensation of gases, especially liquid air, the Röntgen and Becquerel rays, radium and its rays, color-photography, the dynamo-machine, electric light, indeed, most, he asserts, of the investigations and applications of electricity as a source of power, the electric furnace and its fruitful application; in the field of biology almost the whole doctrines of the protozoa and bacteria with their explanations of epidemics, the toxines and antitoxines, the working-out of the doctrine of immunity, the discovery of the finer processes of fertilization and of karyokinesis, the doctrine of descent and Darwinism, and above all, crowning all, the conception and foundation of the great idea of the conservation of energy. These he lists as the discoveries and theories of European investigators during the past fifty years; many of them belong to the immediate past. It would be possible to enumerate a series of men and researches in the domain of the historical and philosophical sciences also, which would easily demonstrate that, in them, too, the main weight of achievement still rests in Europe. He rejoices that Europe, with Germany in the heart of it, has retained up to the present its freshness in intellectual work and its youthful vigor. As long as the climatic factors remain as favorable as they now are there will be no lack of intellectual accomplishment.

Particularly noteworthy is a comment made by Waldeyer on the importance of the retention of individual character in men and institutions. The schooling of German youth has, he thinks, hitherto been good, and he values highly the independence of the German university. Too great a similarity should, he urges, be opposed. The strength of an investigator, of a scholar or of a teacher lies in the development of his peculiar powers. In Germany individuality in investigating and teaching is usually well marked; this, he lays stress on, should be left undisturbed, and, all the more, because in America there is a marked tendency toward making things uniform (*um so mehr, als in der Union alles zu einer gewissen Uniformirung drängt*).

While western Europe still occupies the first place in the field of science, the lecturer warns European workers that they dare not rock themselves to sleep in the pleasant certainty that this will continue to be true. "America's scientific capital is equal to ours; she is well in the way toward preceding us in the culture of the sciences. She has already produced men and performances of the first rank in considerable numbers; over night there may

be more of them. Above all, then, let us seek to keep company with America in the nurture of science. Let us unhesitatingly allow to the Americans what they have which is as good or better than ours; let us receive it from them gladly. And if we, through unceasing vigorous performance, can preserve for ourselves their respect and their attention, we shall, in the field of the sciences, help to knit closer the natural bond which exists between Germany and America."

Young Americans have, up to now, gone to Germany to learn from her teachers, but the time has arrived, Waldeyer continues, when German and European students should also go to America to widen their culture. This scientific intercourse between person and person, university and university, academy and academy should be favored in every way possible. "Let us be as liberal to them as they are toward us in the reception of those who seek knowledge, in offering to them all that they need. Let their published researches be found in our libraries also, at least in the great Royal Library of the capital of the empire. Let us show them in all things that on coming to Germany they come to a people of intellectual affinity, under whose political and social institutions even they, with their free views, may have a feeling of well-being. That they do the same for us can be said, to their praise, by all who have been their guests."

Germans should act toward America, he believes, as Americans do toward Germany; they should try to form a correct judgment of the scientific work of Americans by personal knowledge; more than hitherto, Germans must instruct themselves by visiting the country itself. It would do no harm if every year a number of German students went to America to widen their horizon. The plan of exchanging university professors, already introduced, is highly commendable and should be further realized. While he does not feel called upon to give advice to Americans as to their future relations to Germany, Waldeyer says that he knows that, if Germans can remain at the high scientific level they have hitherto occupied, Americans will need no advice; they will gladly maintain their old relations as regards science, and will extend them. "And thus, aside from all else, looking purely at science and its service, will not, in such intercourse, the noblest and highest mission be fulfilled: the advancement and elevation of culture from people to people?"

It is difficult in an abstract to do anything like justice to such an address. All who are familiar with the beauty of Waldeyer's literary expression will desire to read the report in the original.

Lewellys F. Barker.

SCIENTIFIC BOOKS.

A Select Bibliography of Chemistry 1492–1902. By Henry Carrington Bolton. Second Supplement. City of Washington, published by the Smithsonian Institution. (Smithsonian Miscellaneous Collections, Part of Vol. XLIV.) 462 pp.

The first volume of Dr. Bolton's 'Select Bibliography of Chemistry' brought the literature down to 1892. The first supplement continued the work down to the close of 1897. In 1901, Section VIII., 'Academic Dissertations,' was published separately. The present work continues the whole work down to the close of 1902, and adds many titles, especially of academic dissertations, which had been overlooked in the earlier volumes. The following table will give an idea of the space occupied by the different portions of the book: Section I., 'Bibliography,' 5 pages; Section II., 'Dictionaries and Tables,' 6 pages; Section III., 'History of Chemistry,' 11 pages; Section IV., 'Biography,' 15 pages; Section V., 'Chemistry, Pure and Applied,' 162 pages; Section VI., 'Alchemical Literature of the

Nineteenth Century,' 19 pages; Section VII., 'Periodicals,' 11 pages; Section VIII., 'Academic Dissertations,' 167 pages; subject-index, 66 pages.

Doctor Bolton died on November 19, 1903, while the book was passing through the press and most of the proofreading, as well as the preparation of the index, was done by Mr. Axel Moth, of the New York Public Library. This work has been done with a care and excellence that could hardly have been surpassed by Dr. Bolton himself.

Reference has been made in a previous review to the great value of the list of academic dissertations, and increased value is added by the continuation of the list through 1902 in the present supplement. It is to be hoped that at least this portion of the work will from time to time be brought down to date.

In this connection it is interesting to note not only the great amount of this literature but also the sources from which it emanates. The list includes for the five years, 1898–1902, about 2,350 dissertations, or nearly 500 a year. As we should expect, the dissertations from the University of Berlin head the list, about ten per cent. emanating from this source. It is, however, a surprise to find that the rather unfamiliar University of Rostock comes next with only a dozen less dissertations to its credit. Heidelberg stands a little lower in numbers. Next come Munich, Erlangen and Freiburg in Baden, with about 160 each, and then Leipzig, which we should expect to find relatively much higher in the list, with 130. Basel and Marburg are the only other universities which reach 100. Zürich furnishes about 70 dissertations and then come Bern, Breslau, Freiburg in Switzerland, Geneva, Giessen, Göttingen, Halle, Kiel, Tubingen and Würzburg, each with about 50. This list probably furnishes a pretty good index of the quantity of chemical work done at the different universities, but it must not be overlooked that it is a common practise for students to go for their diplomas to a university where the requirements are known to be less rigid than at Berlin or Leipzig.

The loss of Dr. Bolton to the chemical world is great. Aside from his other work in chemistry, in two fields he was almost unique. As an antiquarian he was always bringing up interesting and valuable information from his rich mine of historical knowledge of the early days of chemistry and alchemy. But, perhaps, it is as a bibliographer of chemistry he will be best remembered. His 'Select Bibliography of Chemistry' might almost be considered a monumental work, so great is its scope and so thoroughly is it carried out. While it has the title of 'select' rather than 'complete,' it is remarkable how little material of value is omitted. It is safe to say that his work is final as far as it goes. His bibliographical work is not limited to that which he personally carried out, for he inspired others in the same field. To his influence we owe most of the bibliographies of special elements and allied subjects, which have been published by the Smithsonian Institution, on the recommendation of Dr. Bolton, as the chairman of the American Association committee on indexing chemical literature.

Now that the 'International Catalogue of Scientific Literature' is under way, a part of the work for which Dr. Bolton was so solicitous has become an accomplished fact. The Smithsonian Institution has for the present ceased publishing special bibliographies of chemical subjects, and in view of the immense mass of nineteenth century scientific literature which ought to be indexed and the need of its systematic treatment, this is undoubtedly wise. Under the circumstances it is doubtful if there is longer reason for the continuance of the association committee, of which Dr. Bolton was from the first chairman and moving spirit. In the field of chemical bibliography, he will have no successor.

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SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Experimental Zoology, Vol. II., No. 3 (August, 1905), contains the following papers: 'A Study of the Germ Cells of Aphis rosæ and Aphis œnotheræ,' by N. M. Stevens. Only one polar body is formed, and there is no reduction in the number of chro-

mosomes in either the male or the female parthenogenetic generations. Reduction in the sexual germ cells is effected by longitudinal pairing of like chromosomes. The behavior of the chromosomes in *Aphis* exactly fulfils the conditions required by Mendel's law of heredity; and their form and size relations offer support to the theory of the 'individuality of the chromosomes.' The results also suggest that sex may be determined in *Aphis* by a change in dominance of the sex-character, brought about by external conditions. 'Regeneration in *Polychærus caudatus*,' by N. M. Stevens and A. M. Boring. So far as regeneration in *Polychærus* has been tested by the authors it seems to be largely a question of 'organization' and 'totipotence' of material, modified in many cases by the folding under and uniting of the anterior cut surfaces. Histological examination of the regenerated parts shows the process to be one of pure morphallaxis. 'The Relation of the Degree of Injury to the Rate of Regeneration,' by Charles Zeleny. The rate of regeneration of a removed chela of the cray-fish is greater when other appendages are removed at the same time than when it alone is removed. A similar result was obtained with other forms, disproving the common belief that an increase in the degree of injury to an animal lowers its vitality and thereby diminishes its capacity for repairing sustained injuries. 'Studies on Chromosomes: 1. The Behavior of the Idiochromosomes in Hemiptera,' by Edmund B. Wilson. The author gives an account of the distribution of the chromosomes to the spermatozoa in several species of Hemiptera, and shows that two classes of spermatozoa are formed, in equal numbers, which differ only in respect to the size of one of the chromosomes (called the 'idiochromosome'). A discussion is given of the bearing of the facts on Mendelian inheritance, sex-determination, and the origin and meaning of the accessory chromosomes. 'The Movements of the Swimming Plates in Ctenophores, with Reference to the Theories of Ciliary Metachronism,' by G. H. Parker. Experiments were made upon *Mnemiopsis* and *Pleurobrachia* and the conclusion reached that transmission of the impulse to ciliary movement is neuroid in character, though this is probably supplemented by mechanical transmission. 'On a General Theory of Adaptation and Selection,' by Henry Edward. Crampton. The 'Principle of the Correlative Basis for Selection' is developed upon the results of the author's statistical and experimental studies upon saturnid lepidoptera. The principle states that selection proceeds with reference to the condition of correlation of the organism, and that this condition involves the whole series of external influences as well as all the internal 'characters' of individuals. 'Experimental Studies on the Development of the Eye in Amphibia: II., On the Cornea,' by Warren Harmon Lewis. The cornea will not form without the optic cup or lens coming into contact with the ectoderm, and the influence of these organs can cause corneal formation in ectoderm which under normal conditions never gives rise to a cornea. The cornea is neither predetermined nor self-differentiating.

The July–August number of the *Journal of Geology* contains an article by Professor W. M. Davis, entitled 'The Geographical Cycle in an Arid Climate,' which he considers under the subheadings of 'initial, youthful and mature stages' and 'the beginning of old age.' Professor Davis concludes that 'the scheme of the arid cycle thus seems to be as well supported by appropriate facts as is the scheme of the normal cycle.' Mr. E. S. Bastin furnishes a 'Note on Baked Clays and Natural Slags in Eastern Wyoming.' Professor Charles S. Prosser contributes an article on 'The Delaware Limestone' which is the upper formation of the Devonian limestones of Ohio, while the lower one is known as the Columbus limestone. It is shown that the limestone in the northern part of the state, which Newberry named the Sandusky and supposed to be the upper formation, really represents the Columbus and, therefore, the formation name Sandusky is dropped and Orton's later one—Delaware limestone—adopted. Mr. Richard S. Lull has a paleontological paper, entitled '*Megacerops Tyleri*, a new species of Titanothere from the Bad Lands of South Dakota,' illustrated by

two plates. The number concludes with a "Comment on the 'Report of the Special Committee on the Lake Superior Region'" by Dr. Alfred C. Lane, stating why he "was willing to accept 'Laurentian' as a term apparently stratigraphic and coordinate with stratigraphic terms."

THE July number of the *American Geologist* contains a biographical sketch with portrait of the late 'Clarence Luther Herrick,' by Professor W. G. Tight. Dr. Ida H. Ogilvie contributes an article on 'The High Altitude Conoplain; a Topographic Form Illustrated in the Ortiz Mountains' of New Mexico. The conoplain is named and described as the plain sloping away from the Ortiz laccolith on all sides which has been partly built and partly cut. Professor W. O. Crosby publishes the first installment of an article on the 'Genetic and Structural Relations of the Igneous Rocks of the Lower Neponset Valley, Massachusetts,' which is stated to be an advance presentation, in outline, of a portion of 'the author's detailed and systematic study of the Geology of the Boston Basin.'

WE have received notice that in October next will be issued the first number of *The Journal of Biological Chemistry*, designed for the publication of original investigations of a chemical nature in the biological sciences, whether concerned with the phenomena of animal or of vegetable life. Without rigidly defining the scope of the *Journal*, it may be stated that its pages will be open (1) to workers in zoology and botany and the branches of knowledge in which these sciences are applied, for such of their researches as are of a chemical or physico-chemical nature; (2) to workers on the chemical side of the experimental medicinal sciences, as physiology, pathology, pharmacology, hygiene, physiological chemistry and bacteriology; (3) to those who are engaged in any branch of clinical medicine, when their researches are of a chemical nature; (4) to the specialist in organic chemistry, who will find here a fitting place for the publication of researches which have biological or medical interest. Contributors will be allowed prior publication of announcements or abstracts in other journals. Every legitimate effort will be made to bring the *Journal* to the notice of foreign readers and workers. At least six numbers will be issued yearly and will constitute a volume, each volume to contain between five and six hundred pages. The responsible editors will be John J. Abel, Baltimore, and C. A. Herter, New York. With them will cooperate as associate editors R. H. Chittenden, New Haven, Conn.; Otto Folin, Waverly Mass.; William J. Gies, New York; Reid Hunt, Washington, D. C.; Walter Jones, Baltimore, Md.; Waldemar Koch, Columbia, Mo.; J. H. Kastle, Lexington, Ky.; Graham Lusk, New York; Jacques Loeb, Berkeley, Cal.; P. A. Levene, New York; A. B. Macallum, Toronto, Canada; J. J. R. McLeod, Cleveland, O.; L. B. Mendel, New Haven, Conn.; F. G. Novy, Ann Arbor, Mich.; W. R. Orndorff, Ithaca, N. Y.; Thomas B. Osborne, New Haven Conn.; Franz Pfaff, Boston, Mass.; A. E. Taylor, Berkeley, Cal.; V. C. Vaughan, Ann Arbor, Mich.; Alfred J. Wakeman, New York; Henry L. Wheeler, New Haven, Conn.

DISCUSSION AND CORRESPONDENCE.

THE MUTATION THEORY.

THE paper by Professor White, beginning on page 105 of this volume, although, it seems to me, somewhat obscure in diction at times, as for instance near the bottom of the first column on page 109, where the expression 'rare genera' probably means isolated genera, is nevertheless most interesting and opens up many lines of thought and contemplation. There seems to be but little doubt that the main argument is wholly correct. The facts have of course long been known, and, in the Darwinian hypothesis relating to the origin of species by gradual evolution, an attempt is made to explain them by lost records or long time intervals of upheaval and denudation, the changes in species being gradually brought about in the meantime in some other region or environment. This assumption will not satisfy the long array of observed facts, however, especially in the case of land animals, and we are forced to adopt some such theory as that of

abrupt mutations in order to account for them. We are familiar with multitudes of cases where genera, orders or even classes seem to appear suddenly, but, as far as known to the writer, not a single instance where any considerable number of the minute morphological variations called for by the Darwinian theory in leading up to the new types, can be satisfactorily traced. It would appear, if the Darwinian theory were correct, that at least a few of the radical replacements by altered forms of life might be traceable by actual fossil remains in the underlying rocks.

The subject was very strikingly brought to my attention some time ago in studying the extensive family Pleurotomidæ of the gastropod Mollusca,—an important group, containing many genera and a vast array of species, which seems to come abruptly into being at the beginning of the Tertiary period. Some species supposed to belong to the family have been described from the upper horizons of the Cretaceous, but these are not sufficiently numerous or transitional in nature to affect the general truth of the above statement. Some of the better defined genera, such as *Gemmula,* appear abruptly in the earliest Eocene, in forms fully as well developed as those now living, and, in fact, some early Eocene species so closely resemble living shells that it is scarcely possible to distinguish them. There is not a particle of generic change, even in the complex embryo, from the time of their sudden appearance at the opening of the Eocene to the present time. Many genera, however, endure only until the end of the Eocene-Oligocene period, when there occurs again a rather universal and abrupt change of generic types.

At Vicksburg, Miss., appears a formation generally assigned to the Lower Oligocene, which may be resolved into two principal horizons, the lower of which is composed of fine light gray fossiliferous sand, with but little admixture of clay and alternating in thin strata with subequal thicknesses of more or less friable limestone, the upper consisting of an equally fossiliferous ferruginous red marl. In some places these two horizons are separated by a bed of blackish-gray compact clay, full of fossils which so closely resemble those of the upper marl that there can be but little question of its properly forming part of the upper horizon. These two horizons were probably separated by a time interval not very great, geologically speaking, possibly not more than a few thousand years—a relatively short time in the life history of most species,—during which the lower beds may have appeared above the ocean and have been subject to denudation until they were again submerged to receive the upper marls, the local conditions having changed somewhat in the interval, as shown by the different constitution of the beds as related above. In regard to the Mollusca of the two horizons, I find after a rather thorough exploration of both, extending over several years, that there is unexpectedly little in common between them. Probably not more than 40 per cent. of the species of either horizon are common to the two, and, in several instances, even these are at least varietally modified. There are, of course, a number of species of the lower beds represented by evident descendants in the upper marls, but what it is desired to lay particular stress upon in this connection, there are many widely divergent or wholly unrelated types appearing in the latter that are not even suggested in the former. Perhaps the exploration is not as yet sufficiently extended, but this is at least the present status of knowledge, with an equally thorough investigation of the two horizons as they are now exposed in the bluff at Vicksburg.

The mutation theory is evidently the best that has been advanced to account for these known facts. It should be especially acceptable to the theologians, also, as they maintain the spiritual and undying nature of man. If we conceive that man originated abruptly by some unaccountable molecular change in the ovum producing the original twins, Adam and Eve, there can be no doubt of the time when man became thus immortal, whereas there would be necessarily much uncertainty as to the time when this occurred among the successive infinitesimal increments of brain development necessitated by the Darwinian theory.

Born thus in the womb of the lower ani-

mals, man has become the most wonderful living thing on earth, separated by a great gulf from his next of kin, and yet, in spite of his high degree, afflicted with more diseases than any other animal and beset by at least as many tormenting parasites. Inexperienced in his early history, his mind steadily advanced until to-day he contemplates all nature with a yearning to know its mysteries. The changes in the germ-cell sufficing to evolve him are as inscrutable to his reason as the constitution of matter and the interstellar ether, the nature and origin of the cosmical forces and of chemical affinity, the conditions obtaining on other worlds revolving about untold millions of other suns, or the origin, nature and meaning of life itself. But we ardently desire to know these things, to peer out into unfathomable space and to speculate upon the meaning of our existence and the unknowable as we perceive it all about us in the universe. Under such circumstances are we to live but a short time on earth and then be consigned to everlasting oblivion? In contemplating the real significance of the word eternal or everlasting, which must refer to infinity—a duration of time so inconceivable that a number of years expressed in pica type encircling the entire globe would be as naught when compared with it—our reason would appear to answer in the affirmative. But, as a species—*sapiens*—of the genus *Homo*, we can never know. We seem to be but intellectual atoms floating in an infinity of space and time.

THOS. L. CASEY.

ST. LOUIS,
August 3, 1905.

SPECIAL ARTICLES.

THE SPEARMAN CORRELATION FORMULA.

SOME time ago C. Spearman published a formula for calculating the true correlation by the Pearson formula for observations in themselves variable.[1] This method has been used by several psychologists without a full understanding of the way in which Spearman arrived at the method. Such a use of the method is dangerous since those who apply it can not be accurately informed as to the conditions under which it holds.

Let

T represent the type.
σ represent the variability of the group.
t represent single observations upon individuals.
N the norm of the individual.
v represent the variability of the individual with respect to his norm, including the error of observation.

Assuming that all t's follow the exponential law and representing averages by [ ], we shall find in the long run that

$$[t] = [N] = T.$$

The observed variability of the group may be expressed as

$$\sqrt{\sigma^2 + v^2}$$

in which σ represents the true variability that determines the true correlation in the Pearson formula. The whole problem in practise is to find the value of v.

Spearman says that the true correlation may be obtained by dividing the average correlation for the various trials of the two tests by the square root of the product of the correlations for the successive trials for each test.

Let,

xy = the average product of the deviations for the corresponding single trials in two tests.
$(pq)_1$ = the same for t_1 and t_2 of the first test.
$(pq)_2$ = the same for t_1 and t_2 of the second test.
v_1 and v_2 = the true variabilities of individuals in the two tests.
σ_1 and σ_2 = the true variabilities as calculated for x and y.

Then by substitution in the formula of Spearman,

$$r^2 = \frac{[xy]^2}{\dfrac{(\sigma_1^2 + v_1^2)\,(\sigma_2^2 + v_2^2)}{(pq)_1\,(pq)_2}}$$

$$r^2 = \frac{[xy]^2}{(pq)_1\,(pq)_2}$$

Hence,

$$\sigma_1^2\sigma_2^2 = (pq)_1\,(pq)_2$$

$$\sigma_1^2 = (pq)_1$$

[1] C. Spearman, *American Journal of Psychology*, January, 1904.

Thus the formula assumes that the successive observations upon the same individual, or t_1 and t_2, are constituents of the same norm in conformity to the exponential law. The method is simply a way of eliminating v from the expression. The assumption upon which the whole rests is that $[pq]$ will be constant no matter what the magnitude of v.

Now, in tests as taken in psychological laboratories it is evident that some change in the norm results with each successive trial. In all tests we find practise, warming-up, etc., as factors leading us to consider the successive t's as ordinates of a curve whose abscissa represents units of time. In practise, at least, we assume a type of curve toward which all individuals tend. The individual curves are variants in the group defined by the type curve. The same conditions are found in growth of stature. It has been shown that individuals tend to the same curve of growth. Also that when an individual varies greatly from the type curve at one period of time he is likely to vary less at another.[2] This implies that the individual tends to fill a space type in a time type so far as his physical growth is concerned. If this is true we should expect to find the same relations with respect to the form of any organ.

I have at hand data for measurements of the alveolar arch with reference to the median plane of the body. These measurements were taken as ordinates of the curve as defined by the teeth. This gives us the same general geometric conditions as were found in curves of growth. Now, before going on with the data let us consider the problem as that of a correlation between the ordinates of individual curves, varying from the type curve according to the exponential law.

We may assume that OM represents any curve. Let t_1 be the first observed trial or ordinate; t_2, the second. Now, no matter what the value of t_2 may be, there must be a correlation between t_1 and t_2 because of their geometric relations. Also, there may be a relation between $(t_1 - t_2)$ and t_2.

Let

[2] Franz Boas, Report of the Commissioner of Education for 1896–7.

$[t_1] - [t_2] = [P]$,

σ_1, σ_2, σ_3, the respective variabilities of these averages,

$x =$ the deviations of t_2 from $[t_2]$,

$y =$ the deviations of t_1 from $[t_1]$,

$y = x + p$.

Then $(x + p)$ is a variable agreeing with a variable y; p is the deviation of $[P]$.

$$[xy] = [x^2] + [xp],$$

$$[y^2] = [x^2] + 2[xp] + [p^2].$$

Also

$$[y^2] = \sigma_1^2,$$

$$\sigma_1^2 = \sigma_2^2 + \sigma_3^2,$$

$$[y^2] = [x^2] + [p^2].$$

Hence, $[xp]$ should be zero, but this can occur only when there is no correlation between t_2 and P.

The value of p may be expressed as

$$[p^2] = [y^2] - 2[xy] + [x^2].$$

Thus, the various terms of these equations can be calculated from the data for the correlation of t_1 and t_2.

I have calculated the following for the successive ordinates of the alveolar arch:

	$[xy]$	$[xp]$	σ_3	r_{xy}	r_{xp}
$t_1 t_2$	+ 6.08	+ 1.67	2.8	+ 0.71	+ 0.28
$t_1 t_3$	+ 5.03	+ 0.62	2.3	+ 0.67	+ 0.13
$t_1 t_4$	+ 3.91	− 0.50	2.8	+ 0.52	− 0.09
$t_1 t_5$	+ 2.70	− 1.71	2.9	+ 0.38	− 0.27

In this table I have correlated the smallest dimension with each of the successively large dimensions as indicated by t. $[x^2]$ is taken as a constant; σ_3 appears to be constant. The correlation of t_{n-1} and P varies for different points in the curve OM, in such manner that two points may be found for which the correlation is zero. $[xp]$ varies with the magnitude of $[P]$, which in this curve is dependent upon the distance between t_1 and t_2.

I have no good data for a psychophysical test. The only available data, at this writing, are the reaction times in the Columbia University tests. To preserve the form of the preceding table the fifth reaction was taken as the point of departure. Thus:

	$[xy]$	$[xp]$	σ_3
$t_5\,t_4$	+ 7.78	— 8.00	4.8
$t_5\,t_1$	+ 4.13	— 11.63	4.9

The result is similar to that in the foregoing. $[xp]$ is negative with respect to consecutive trials. I have not calculated the values for all of the five trials because reaction time is not a good case; the distributions being asymmetrical, a disturbing factor is present. This will require special investigation.

These few observations lead to the following hypothesis: When a geometric form is taken as the type of biological activity the correlation between one dimension, taken as fixed, and its variation from another dimension will range indefinitely as positive or negative according to the geometric relations between the points from which the measurements are made. When two dimensions are correlated the degree of correlation will be increased or decreased by virtue of the equalization between the above correlation and the correlation between the parts common to both.

The method used by Spearman to determine the true correlation for psychological tests in which t_1 and t_2 seem to represent ordinates of a similar curve, assumes that $[pq]$ will be constant for the successive trials. Turning to our last formula and substituting

$$[pq] = [x^2] + [xp].$$

we have shown that $[xp]$ is a variable of uncertain range causing $[pq]$ to vary. Thus an unknown variable is introduced by the use of the Spearman formula. There is reason for assuming that $[xp]$ will be negative in many psychological tests, thus reducing $[pq]$, whence the method of Spearman will give correlations artificially increased.

To put it in another way, the formula of Spearman assumes that

$$r_{t_1 t_2} = \frac{[pq]}{\sigma_1 \sigma_2} = 1$$

or

$$= \frac{[pq]}{\sigma_1^2} = 1.$$

It is evident that this can be only when t_1 and t_2 are identical. $[pq]$ will be a constant when t_1 and t_2 are of the same type. We have shown above that the method of observation will sometimes result in a geometrical relation between t_1 and t_2 causing $[pq]$ to vary. Whenever this occurs the method fails.

CLARK WISSLER.

TREATMENT OF SIMPLE HARMONIC MOTION.

THE very great importance of simple harmonic motion in the physical world demands very careful consideration of the method of presenting and treating it for students beginning the work in advanced physics.

From the books on physics which I have at hand, I have selected fourteen which are used by a large portion of American students for their first study of simple harmonic motion. Eleven of these present and define simple harmonic motion merely as the projection on a diameter of uniform circular motion, deriving equations and other definitions by use of this uniform circular motion. Some of them scarcely suggest the question whether there really is such motion; much less, under what conditions or by what law of force it would occur.

Three of the fourteen texts give simple harmonic motion a *dynamic* definition, presenting it as produced by a force acting toward and varying as the distance from a center. But even these three, in treatment, make the *auxiliary circle* very prominent.

An experience of a good many years with large numbers of students leads me to believe that in the minds of very many the *auxiliary circle* with its functions and *circular motion* 'looms larger' than the actual simple harmonic motion. It seems to me highly desirable to dispense with the auxiliary circle in both definition and treatment.

The definition should be dynamic. This dynamic definition should be drawn from experiments.

The treatment should be a problem, a study of the motion caused by a force acting by the law found in the experiments.

I offer the following as an illustration of treating simple harmonic motion as above suggested; and for students not using calculus.

Experiments.—One or more on each, flexure,

elongation, torsion. Find the law of force and displacement, stress and strain.

Problem.—Find mathematical expressions for the motion of a free particle under such a law of force.

Take ee' as the path, with center c. Let h equal the acceleration at unit distance from c; and let the acceleration at any point in the path be directed toward c and vary as the distance from c.

$ce = a$, *amplitude.*

$ck = a.h$

$cp = x$, a variable, *displacement.*

then

$\frac{1}{2}a.a.h =$ work from e to c.

$\frac{1}{2}x\frac{x}{a}a.h =$ work from p to c.

$\frac{(a^2-x^2)h}{2} =$ work from e to p.

$= \frac{1}{2} V^2$, velocity squared, if work was done on unit mass.[1]

$$V = \sqrt{h}\sqrt{a^2\left(1-\frac{x^2}{a^2}\right)} = a\sqrt{h}\sin\theta,$$

$$\theta = \cos^{-1}\frac{x}{a}.$$

To construct this geomerically and determine the constant $a\sqrt{h}$.

For any point, p, with $cq = a$, construct θ pcq, by bringing q into the perpendicular from p.

Take qr perpendicular to cq, $= a\sqrt{h}$ on some scale (which need not be known).

On qr make the right triangle qsr, $r = \theta$.

Then $qs = a\sqrt{h}\sin\theta =$ velocity at p in the simple harmonic motion.

Let $T =$ the *period*, the time of a complete vibration, from e to e' and back to e; and let $t =$ any portion of time.

If cq is given a uniform angular velocity $2\pi/T$, that is, θ is made to vary uniformly with time, the component of q's motion parallel to p's path will at every instant equal the motion of p. The linear velocity of q, $2\pi a/T$, is equal to the constant $a\sqrt{h}$. θ is at any instant (reckoning time from leaving e) equal to $2\pi t/T$.

Hence, for velocity at point, p, in simple harmonic motion,

$$V = \frac{2\pi a}{T}\sin\frac{2\pi t}{T}.$$

From this the equation for acceleration can be obtained. Phase and epoch can be defined and introduced into the equations.

I. Thornton Osmond.

[1] Unit mass was taken to simplify work in getting the form of the equations. The relation of mass to simple harmonic motion should be determined and put in the formulæ. Though only two or three of the text-books under consideration make any allusion, even, to mass.

THE BRITISH ASSOCIATION AND AFFILIATED AND CORRESPONDING SOCIETIES.

The report of the council of the British Association presented at the South African meeting the following resolution, from the conference of delegates, was referred to the council by the general committee for consideration and action, if desirable:

(i.) That a committee be appointed, consisting of members of the council of the association, together with representatives of the corresponding societies, to consider the present relation between the British Association and local scientific societies.

(ii.) That the committee be empowered to make suggestions to the council with a view to the greater utilization of the connection between the association and the affiliated societies, and the extension of affiliation to other societies who are at present excluded under regulation 1.

This resolution, having been referred to a committee, consisting of Dr. E. H. Griffiths, Sir Norman Lockyer, Professor Meldola, Mr. F. W. Rudler, Mr. W. Whitaker and the general officers, to consider and report thereon to the council, the committee made the following recommendations:

I. (i) "That any society which undertakes local scientific investigation and publishes the results may become a society *affiliated* to the British Association.

(ii.) "That the delegates of such societies shall be members of the general committee.

(iii.) "That any society formed for the purpose of encouraging the study of science, which has existed for three years and numbers not fewer that fifty members, may become a society *associated* with the British Association.

(iv.) "That all associated societies shall have the right to appoint a delegate to attend that annual conference, and that such delegates shall have all the rights of those appointed by the affiliated societies, except that of membership of the general committee."

II. The committee further recommend that the council request the corresponding societies committee—

(i.) "To collect information as to the societies of the United Kingdom who might become associated societies under rule 1.

(ii.) "To consider and report on the question of 'A Journal of Corresponding Societies' referred to in Principal Griffith's Report."

III. The committee also recommend—

"That the council, in nominating a chairman of the conference of delegates, should choose one of their own body."

On the recommendation of the corresponding societies committee, the following resolution, remitted to the committee and embodying subsequent amendments, has been adopted by the council:

BY-LAW.

I. (i.) "That any society which undertakes local scientific investigation and publishes the results may become a society *affiliated* to the British Association.

(ii.) "That the delegates of such societies, who must be or become members of the British Association, shall be *ex officio* members of the general committee.

(iii.) "That any society formed for the purpose of encouraging the study of science, which has existed for three years and numbers not fewer than fifty members, may become a society *associated* with the British Association.

(iv.) "That all associated societies shall have the right to appoint a delegate to attend the annual conference, and that such delegates shall be members or associates of the British Association, and shall have all the rights of those appointed by the affiliated societies, except that of membership of the general committee.

II. "That the corresponding societies committee be requested to collect information as to the societies of the United Kingdom who might become associated societies under rule I. (*corresponding societies*).

III. "That in nominating a chairman of the conference of delegates, rule VIII. (*corresponding societies*) be allowed to stand."

THE NEW MUNICH CLINIC.

THE completion of the new University Clinic in Munich for nervous and mental diseases marks an important epoch in the progress of humanity, no less than in the history of medicine. From the time when William Griesinger, forty years ago, planned the first modern hospital for the insane, the leading authorities in Germany have labored to perfect the plans and organization of institutions of this class, with the result that the Munich Hospital will serve for years to come as a model to be copied by other nations. Whether the clinic is judged by the opportunities it affords for the observation and treatment of nervous and mental diseases, by the provision it makes for the instruction of students or by the facilities it offers to those engaged in the scientific study of the brain, it stands unique. Without detracting from the remarkable advances made during the past fifty years in surgery, pathology and bacteriology, it may be affirmed that no greater progress has been recorded in the history of medicine than has occurred in psychiatry during the period that began when Pinel, in the wards of the Salpêtrière first removed the chains from the insane, and that culminated in Germany in the movement that has rendered possible the completion of the Munich Hospital. Nearly forty years have passed since university and state authorities in Germany, influenced largely by the teaching of Griesinger, realized that the study of the brain, with a view not only to the discovery of the means for the prevention of insanity, but also to determine the most efficient methods of increasing the power to think and act normally, includes the discussion of many problems as important to mankind as the enquiry concerning the origin and spread of infectious diseases or the growth of tumors. The plans for the hospital in question are not entirely of recent creation; they represent the experience gained in the construction of twenty-two hospitals of similar type which exist in the German empire, and of which not a single example is yet to be found in an English-speaking country.

As an excellent general description of this

clinic has been given in a consular report by Mr. Mason,[1] the American consul general in Berlin, and as a book containing detailed plans is soon to be issued by Barth, of Leipzig, only a few points of general interest will be referred to, here and now. The plot of ground on which the clinic stands was given by the city of Munich and is within a stone's throw of the other buildings which form the medical department of the university. The hospital building, which has accommodations for one hundred and ten bed patients, affords no evidence of money wasted in unnecessary architectural adornment, and yet is in excellent taste. The ground plan exhibits a central building and two L-shaped wings enclosing a small garden, at the back of which are the kitchens and laundries. In the central building are rooms for the examination of new patients; the out-patient department, or dispensary; an amphitheater with seating capacity for two hundred and forty students; a library, where the daily conferences of the staff are held; rooms for anatomical, pathological and psychological investigations; clinical and chemical laboratories; a brilliantly lighted room, where patients and specimens may be photographed—a room for photomicrography and apartments for the use of the six resident and two non-resident members of the medical staff.

In visiting the wards one is impressed with the fact that neither in the general plan, nor in the furnishing, is there anything which serves to recall the old asylum methods of treating patients. No form of mechanical restraint is used; even 'canvas jackets' and 'restraint sheets' are to be found only in the collection of articles which serve to illustrate the old-fashioned methods of treatment and nursing. The remarkable quiet of the patients, in spite of the fact that most of these are in the acute stages of their alienation, is due in large measure to opportunities afforded for keeping them in continuous baths, a form of treatment rendered possible only by the use of specially constructed baths and bath rooms. What follows will give an idea of the care and ingenuity shown in planning the details of the hospital. The night-nurses in each ward, when not attending patients, sit at a small table at which the light is so shaded that it can not possibly disturb any of the patients. Should the nurse desire, she can at any moment, without moving from her position, turn on one or all of the lights in the ward suddenly, or by means of a current controller, slowly; she can telephone to any member of the medical staff, and can, without leaving her seat, heat water or milk on a small electric stove. The keys to the light, the telephone, the stove, the register, which the nurse touches every half hour, the recording dial of which is in the room of the chief physician, are all concealed in niches in the wall, closed by small doors which can be opened only by the nurse's key.

An important preliminary to the actual treatment of patients is the ease with which new cases are admitted to the institution. In many instances patients are brought at their own request to the clinic or are sent to the wards directly from the out-patient department. Those who are dangerous either to themselves or the community and refuse to be detained may be held by the director of the clinic until sufficient time has elapsed to observe the case carefully, and then, if the patients still demurs to confinement, an appeal may be made to a justice, who at once appoints a committee of three to report upon the condition of the patient and the validity of the demurer.

Ample provision has been made for the teaching of students. In the out-patient department there are abundant facilities for the demonstration of the cases to small classes of students, while in the amphitheater every possible opportunity is afforded for the substitution of demonstration and object lessons for didactic lectures. Should it be necessary during a lecture to use the magic lantern, projection apparatus, epidiascope, or even the kinematograph, the brilliantly lighted room may be darkened by pressing a button, which starts an electric apparatus that lowers and raises heavy black curtains. The space de-

[1] Daily Consular Reports, No. 2264, May 22, 1905, Department of Commerce and Labor, Washington.

voted to the several departments in which research work is conducted is surprisingly large. The study of all questions bearing directly upon the anatomy and finer histology of the brain is carried on in a perfectly equipped laboratory. Two smaller adjoining rooms are reserved for the use of the director of the laboratory. Seven rooms are set apart for the use of those who are engaged in following lines of work in experimental psychology or physiology, while separate quarters have been assigned to both the clinical and chemical laboratories. Among the more interesting items of the new equipment noticed in the psychological department was an elaborate, but exceedingly ingenious, apparatus for the exact measurement of the pupillary reactions in response to light, sound and smell stimuli.

A word may be said with reference to the duties of the director of the clinic, who is also professor of psychiatry in the university. His word as to what patients shall or shall not be admitted to the clinic is final and he may, at any time he thinks proper, discharge or have a patient transferred to an asylum.

Although not forbidden to engage in private practise, it is expected that the director's time will be chiefly occupied in teaching students, supervising the work done in the various laboratories and in carrying on scientific investigations. The fact that professorships of psychiatry in Germany are in the true sense of the word academic positions, enables the director of a clinic to keep *au courant* with his profession, to have more time for study, and is thus fitted to be a more stimulating teacher and more intelligent investigator than is possible in those countries where the alienist devotes most of his energies to administrative duties or to private practise.

The incalculable advantage of having a director of a hospital who, not only by precept, but also by practise, encourages his assistants and students to undertake the solution of new problems is of the greatest importance.

The American who visits the Munich clinic and takes a comprehensive view of the great forward movement in medicine to which this institution is a monument may well ask himself the question, How long will our leading universities be without adequate means and opportunities for the organized systematic study of the most important organ of the body, whose functions professors and teachers seek to train? The most liberal contribution from a private individual that has yet been made in Germany to an institution devoted to the study of the brain was that of Herr Krupp, the maker of big guns. This far-sighted and philanthropic man saw that the time had come when the study of the brain of the man behind the guns was a matter of the greatest importance to the German empire, and with this aim in view he not only founded, but endowed, the Neurobiological Institute in Berlin. This institution has for its sole object the investigation of various problems connected with the structure and functions of the nervous system, and, although deserving a fuller description, is briefly referred to here, in order to direct attention to the widespread interest that these questions are receiving in Germany.

STEWART PATON.

STANDARD TIME IN AMERICA.

THE annual report of the Superintendent of the U. S. Naval Observatory for 1904 has stated on page 14 that the adoption of the standard time system of this country is the outgrowth of the efforts of the naval officers on duty at that institution.

The more detailed history of this interesting subject is about as follows: The astronomers in charge of the numerous observatories of this country (usually connected with universities) have always felt the necessity of contributing their quota to the public welfare, and whenever possible have regulated the local public clocks and the time systems for the local railroads. This work began with the labors of W. C. Bond (1820–1860), whose private observatory in Boston developed into the magnificent Harvard College Observatory at Cambridge. Bond not only regulated the time furnished to the shipping in Boston and to jewelers and that shown by the public clocks, but also especially the clocks of the railroads centering in that city. About 1840 Professor O. M. Mitchell began to regulate from the Cincinnati Observatory the time used by the

railroads in that city, and the work was continued by Twitchell, Davis, Abbe, Stone and Porter. About 1855 the Dudley Observatory at Albany undertook the control of the time of the New York Central Railroad, and its work was kept up by Hough, the U. S. Signal Service and Boss. About 1867 the Allegheny Observatory began regulating the time of the railroads centering in Pittsburg, and Wadsworth and Keeler kept up this work of Langley. In Chicago, beginning with 1865, Professor T. H. Safford regulated the time system from the Chicago Observatory. About 1850 a time ball was established on the U. S. Naval Observatory at Washington, and by 1870 telegraphic communication had been established between it and some of the government buildings in that city. About 1880 the Yale College Observatory, under Dr. Leonard Waldo, established a bureau of standard time for the state of Connecticut.

In all the preceding cases each observatory sent out its own local mean time as the standard for local use, and also gave the railroads whatever standard time they might require for their use. Local standard times were also furnished to the vessels in the ports at Boston, New York, Washington and elsewhere, and the navigators obtained Greenwich time by adding the corresponding difference of longitude. At that date no one seems to have thought it practicable to distribute a uniform standard of time for public use.

In 1870 General A. J. Myer, in organizing the telegraphic service of the Weather Bureau, required that all observations and telegraphy for the tridaily weather maps should be done simultaneously on the time proper to the meridian of Washington, while another set of observations was kept up for climatological purposes on local time. In 1871 the simultaneous work was, by mutual consent, extended to the vessels at sea, and in 1873 to observers of all nations throughout the world; all simultaneous records that were made for the Signal Service and published in the Bulletin of International Observations were originally made at 7:30 A.M. Washington, or 12:43 P.M. Greenwich, standard time.

About 1878 corresponding simultaneous work was ordered to be done on the U. S. naval vessels. In the course of his study of observations of the aurora of April, 1874, Professor Abbe had occasion to state that much trouble arose from the fact that the numerous correspondents had used such a great variety of standards of time, many of which could not be identified at all; that the words 'railroad time,' 'local time,' or 'standard time' seemed to have no definite meaning, and that when several railroads passed near an observer it was really impossible to ascertain what particular railroad time was adopted by him. In May, 1875, he requested the president of the American Metrological Society, Dr. F. A. P. Barnard (president of Columbia University), to consider whether the reform of standard time could not properly engage the attention of that society. The society at once appointed Professor Abbe chairman of a committee to consider that subject, and his reports are published in the proceedings of the society for May, 1879, and subsequent years. The position was taken that Greenwich standard time and Greenwich longitude should be adopted. But before making the detailed report it seemed necessary to arouse public opinion on the subject, and numerous articles were published by himself and friends in the daily papers, monthly magazines and scientific journals. Eventually the full report of the committee, a pamphlet of twenty-seven pages, was published in May, 1879, in which the existing state of confusion and the beauty of a simple, practical system of standard meridians at even hours east or west of Greenwich were set forth.

It recommended most positively the schedule of standard hour meridians now in use; it also urged that one standard would be still better and equally practicable. The publication of this report brought out the fact that Professor Charles F. Dowd, Mr. Sanford Fleming and Mr. W. F. Allen, secretary of the General Time Convention of Railroad Officials, had also thought along similar lines. It was evident that such a radical change from current practise could best be initiated by the railroad companies as the committee had reported. Accordingly, after a consider-

able discussion in the public press, which the committee encouraged in order to bring out all possible objections and as a matter of public education, it requested the president of the Metrological Society to recommend the suggestions in this report to the consideration of the General Time Convention.

Mr. Allen now took up the subject with renewed energy. By two years of intense discussion and correspondence he was able to enlist the majority of the railroads in support of the Greenwich hour system. The success of the reform rested wholly with him. President Barnard distributed widely the various circulars of the American Metrological Society on standard time. The chief signal officer, General William B. Hazen, adopted the idea of the proposed reform with the greatest enthusiasm. The signal office had already found it necessary to instruct some of its men in the astronomical methods of determining time, and its observers at Dudley Observatory and elsewhere, in addition to their regular meteorological duties, were now regulating local time and even local railroad time when no special astronomers were available for that purpose. In order that the standard of time sent to signal service observers daily should be correct to the nearest second, so that such miscellaneous observations as atmospheric electricity, auroras, thunder storms, earthquakes, meteors, might not be deficient in accuracy, Professor Frank Waldo suggested the plan and General Hazen authorized what might be called a general clearing house for all the astronomical observatories that wished to cooperate with him. It was arranged that an early morning signal should be telegraphed, say at 11 A.M., and automatically recorded by the chronograph and clock of the Signal Service at Washington. Among these signals some would always be very accurate because the respective observatories had clear weather and had just made a good time determination during the preceding night, while others would be relatively inaccurate because of cloudy weather at the respective localities where the observatories had been necessarily relying upon their clock rates for several days. By combining all these into one general mean giving appropriate weights it thus became possible to send back to each observatory a statement as to how much its own clock was in error as compared with the mean of all throughout the country. Such a beautiful system as this might with propriety have been inaugurated by any astronomical observatory, but an extensive correspondence had shown that the signal service was the only institution with which all the observatories and astronomers were disposed to cooperate in this work.

That some such plan was, and is now, desirable is shown by the fact that a comparison of the standard time signals of the U. S. Naval Observatory, the Harvard College Observatory and the Alleghany Observatory, made each day during several years at New York by the Western Union Telegraph Company, showed large differences, amounting to as much as five seconds in some few cases and frequently exceeding two seconds.

Unfortunately, however, in 1884, shortly before the clearing-house system was to go into operation, some evil-minded person seems to have induced the secretary of the navy to believe that the Signal Service, in its desire to secure accurate time, was exceeding its own legitimate duties, and an order came from the secretary of war forbidding further action, and even requiring the removal of the elegant clock from its ideal location in the basement of the War Department building. This was the first clock in this country to be so mounted that the air pressure and the air temperature to which it was subjected would remain constant. The country was thus deprived, at least temporarily, of the prospect of obtaining the most accurate possible time service for the use of both astronomers and the public, and the U. S. Naval Observatory continued its struggle against the use of standard hour meridians.

Meantime, however, Mr. Allen had induced the railroads to agree that his standard hour system should go into effect on the eighteenth of November, 1883. In order to realize this result it was necessary that the observatories giving time to the railroads and local communities should change to the new system of hour meridians. This change in public clocks and

by the railroads was to be made during the morning of the eighteenth, but a few days before that Mr. Allen wrote Professor Abbe, saying that he feared some embarrassment if the Harvard College Observatory should fail to change its public time signals, as the director of the observatory was absent from the country. Accordingly, a telegram from General Hazen to President Eliot urged that by reason of its eastern longitude Harvard College and New England should have the honor of thus beginning the desired reform. The people as well as the railroads of New England began the good work on that Sunday morning.

By an agreement with the Western Union Telegraph Company, made about 1877, that company sold its time signals received from the Naval Observatory to its customers throughout the country who would pay for them. This was, probably, the only case in which a government institution cooperated with a corporation to sell that which would seem to be government property and without any return to the Treasury. Of course the telegraph companies made equivalent returns to the government by allowing the free use of their lines for longitude purposes, but it seemed rather hard that this last concession, which had been in effect since 1845, should be used as an argument for maintaining a popular distribution of time signals that cut under or competed with the work of local astronomical observatories. Of course on November 18, 1883, at the request of the telegraph company the Naval Observatory began sending signals on the 75th standard for transmission to the railroads, but its own time-balls and signals for use in Washington city continued to be regulated by Washington local mean time until March 1, 1884.

In conclusion it may safely be said that the adoption of the present system of standard hours, with all its manifold advantages, has been accomplished by persons outside the government service. The officials of our railroads have lately united in ascribing the successful introduction of standard time to Mr. W. F. Allen, without saying a word in favor of the Naval Observatory's pretensions.

SCIENTIFIC NOTES AND NEWS.

Dr. George F. Kunz, of New York City, has been appointed by the State Department a delegate to the International Congress for the Study of Radiology and Ionization, which will be held in Liège, Belgium this month.

We learn from the *American Geologist* that Professor T. C. Chamberlin has been appointed a member of the Illinois Geological Survey Board. The other members are *ex-officio* Governor Deneen and President James, of the State University.

Mr. E. C. Chilcott, agronomist of the South Dakota Agricultural Experiment Station, has been appointed expert in connection with the cereal work of the Department of Agriculture.

Dr. Walter Schiller has been appointed head of the geological division of the Museo de la Plata and geologist of Buenos Ayres.

On the occasion of the installation of Mr. Andrew Carnegie as lord rector of St. Andrew's University on October 17, the university will confer the honorary degree of doctor of laws on Mr. Carnegie; Mr. Whitelaw Reid, the American ambassador to Great Britain; Mr. Charlemagne Tower, the American ambassador to Germany; Bishop Potter of New York; Dr. Nicholas Murray Butler, president of Columbia University, and Dr. William J. Holland, director of the Carnegie Museum at Pittsburg.

A memorial in honor of Professor Friedrich von Esmarch, the eminent surgeon of the University of Kiel, has been erected in his native place, Tönningen in Schleswig-Holstein. Professor von Esmarch was present at the unveiling, which took place on August 6.

M. Vidal de la Blache has received the medal of the Paris Geographical Society in recognition of his work, 'Tableau de la Géographie de la France,' which is the introduction to the 'Histoire de France,' published under the direction of M. E. Lavisse.

Secretary Wilson has made public the report of Solicitor George P. McCabe on the investigation of the charge that Dr. Daniel E. Salmon, head of the Bureau of Animal

Industry, was improperly interested in the firm of George E. Howard and the Howard Label Company. Secretary Wilson's indorsement on the report is as follows: "Inquiry discloses the fact that Dr. Salmon had an unfortunate connection with the firm of George E. Howard & Co. While this connection was not an ideal relation for a government officer to have with a firm doing business with the department, I am convinced that Dr. Salmon never intended to profit by work done by Mr. Howard for the Department of Agriculture, and that he has never been connected with the Howard Label Company or received any benefit from the contract of that company with the department. The action of the department regarding the meat inspection service was as fair, considerate and comprehensive as the appropriations would warrant. The case does not seem to call for further disciplinary action."

THE statement which we quoted from the *American Geologist* in regard to the change in the directorship of the Geological Survey of Michigan was incorrect. In regard to the survey, we are informed that the director, Professor A. C. Lane, is engaged in detailed studies in the copper region. Professor I. C. Russell is making an examination of the surface geology in the Upper Peninsula, and Mr. Frank Leverett, of the United States survey, is studying the same problem. They are working in cooperation. Professor C. A. Davis is studying the development and ecology of the peat bog flora. Mr. W. C. Gordon is completing a cross section of the copper-bearing formation to determine the different horizons near the Wisconsin line. Professor W. M. Gregory is finishing his report on Arenac County. Mr. W. F. Cooper is working on the Wayne County report and watching the shaft going down to rock salt, near Detroit.

PLANS for the cooperative investigation of the artesian waters in the vicinity of Wilmington, North Carolina, have been arranged by the United States Geological Survey and the State Geological Survey of North Carolina. It is expected that the work will be in charge of Mr. M. L. Fuller, who will be assisted by Mr. L. W. Stephenson, of Johns Hopkins University, and Mr. B. L. Johnson, recently of the Massachusetts Institute of Technology.

CHARLES E. BROWN, curator of the Wisconsin Archeological Society, has returned from a week in the field plotting mounds and collecting archeological data in the vicinity of Beaver Dam and Fox Lakes in the western part of Dodge County, Wisconsin, and is now preparing the society's exhibit of archeology for the state fair.

ON August 9 the London County Council erected a tablet on the house in which Edward Jenner, the discoverer of vaccination, lived during 1803.

IT is proposed to erect a memorial to the late Professor Emerich Meissl in the agricultural experiment station at Vienna, with which he was connected for more than twenty years.

PROFESSOR ELLIS A. APGAR, for twenty years state superintendent of public instruction in New Jersey and a writer on botany, died at East Orange, N. J., on August 28.

DR. ROBERT BILLWILLER, director of the Swiss Meteorological Bureau, died in Zurich on August 14, at the age of fifty-six years.

IT appears from cable despatches to the daily papers that the weather was very favorable for observations and photographs of the total solar eclipse on August 30 for the large number of parties of different nationalities that went to Spain, Algeria, Tunis and Egypt. The weather was unfavorable on the Island of Majorca. In this country the partial eclipse was obscured by clouds.

REUTER'S AGENCY telegraphs that members of the British Association arrived at Durban on August 22. They proceeded to Pietermaritzburg on August 24, where they were welcomed by the governor of Natal. A number of excursions were made on the twenty-fifth, and the members left for Colenso on the twenty-sixth.

THE seventy-seventh meeting of German Men of Science and Physicians was held in Meran last week under the presidency of Dr. Franz von Winckel, professor of gynecology

at Munich. At the general sessions papers were presented by Professor W. Wien, of Würzburg, on 'Electrones'; Professor Nocht, of Hamburg, on 'Tropical Diseases'; Professor H. Molisch, of Prague, on 'The Reaction of Plants to Light'; Professor H. Dürck, of Munich, on 'Beri-Beri'; Dr. Cl. Neisser, of Lublinitz, on 'Individuality and Psychoses'; and by Professor J. Wimmer, of Vienna, on the 'Mechanics of the Development of Animals.' At a meeting of the entire association papers on heredity were presented by Professor C. Correns, of Leipzig; K. Heider, of Insbruck, and B. Hatschek, of Vienna. The association met in thirty sections for the reading of scientific papers, of which seventeen were in medicine and thirteen in natural science, the latter being as follows: (1) Mathematics, astronomy and geodesy; (2) physics; (3) applied mathematics and physics; (4) chemistry; (5) applied chemistry; (6) geophysics and meteorology; (7) geography; (8) mineralogy, geology and paleontology; (9) botany; (10) zoology; (11) anthropology, ethnology and archeology; (12) mathematical and scientific education; (13) pharmacology.

The sixth Congress of Criminal Anthropology will meet at Turin on April 28, 1906, under the presidency of Professor Lombroso. An exhibition of criminal anthropology will be held in connection with the congress.

The nineteenth annual convention of the Association of American Agricultural Colleges and Experiment Stations will be held at Washington, D. C., in the early part of November next.

The Sank County Historical Society has been organized, in Wisconsin, to further archeological and historical research, by Messrs. A. B. Stout and H. E. Cole, members of the Wisconsin Archeological Society.

From June 21 to 26, 1906, a large agricultural exposition is to be held at Berlin, which will also comprise a special division for preserved-food articles, such as products of the dairy, dough, potatoes, fruits, wines and extracts, meats, beer, etc. Money prizes, diplomas and medals will be awarded. In order to test the preserving capacity of these exhibits they will be sent to the tropics.

UNIVERSITY AND EDUCATIONAL NEWS.

By direction of the late Mrs. Adolphus F. Eliott, a hospital, to cost $175,000, has been given to the University of Minnesota.

The University of Melbourne attains its jubilee next year, and preparations are already in progress to celebrate the event.

The board of Trinity College, Dublin, has instituted a diploma in economics and commercial knowledge. The course for the examination includes, as obligatory subjects, the theory of economics, commercial history and geography, accountancy and commercial law; and as optional subjects a modern language (French or German or Spanish), any one of a variety of special economic subjects, and any one of the following branches of economic and business organization—banking, railways, insurance, agriculture.

The summer course in experimental phonetics at the University of Marburg was delivered this year by Dr. E. W. Scripture. The course had been previously given by the Abbé Rousselot, of the Collège de France, Paris.

Mr. Samuel M. Kintner, for some years professor of electrical engineering at the Western University of Pennsylvania, has been appointed associate professor of electrical engineering in the Carnegie Technical School.

Mr. W. P. Brooks has been appointed director of the Massachusetts Agricultural College and Experiment Station, in succession to the late Henry Hill Goodale.

M. Lavasseur, the statistician, has succeeded M. Gaston Paris as executive head of the Collège de France.

Dr. Verneuil and Dr. Rosenstiehl have been appointed professors of applied chemistry in the National Conservatory of Arts and Measures. Dr. Deperet has been appointed professor of geology and mineralogy in the faculty of sciences at the University of Lyons and Dr. Rivals professor of technical chemistry at Aix-Marseilles.